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1 DYED FABRIC MATERIAL, METHOD OF PRODUCING THE SAME
2 AND USE OF THE FABRIC MATERIAL IN THE MANUFACTURE OF
3 SPORTS BALLS

4
5 The present invention relates to fabric material
6 particularly suitable for the manufacture of sports
7 balls and to a method of obtaining the same. More
8 particularly it relates to a new method of dyeing
9 woven or not woven material which provides the
10 material with high visibility characteristics. The
11 invention also relates to the dyed material thus
12 obtained and to the use of such material for the
13 manufacture of sports products and particularly for
14 the covering of tennis balls.

15
16 Traditionally, tennis balls were covered with white
17 woollen felt. Several decades ago yellow felt was
18 introduced for use on match quality balls and from
19 the early 1970's balls covered with yellow felt
20 became increasingly popular. Today, the vast

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1 majority of tennis balls are covered with yellow
2 felt. Rule 3 of the International Tennis Federation
3 Rules of Tennis states "The ball shall have a uniform
4 outer surface consisting of a fabric cover and shall
5 be white or yellow in colour...".

6

The felt used on tennis balls was previously made from wool. Increased wear properties are obtained by including a proportion of synthetic fibres in the felt, and nowadays such felt is usually made of a mixture of wool and nylon fibres. The proportions of wool and synthetic fibres used to produce the felt can vary, but typically a ratio of 40:60 to 60:40 can be used (by weight of weft yarn). It is desirable that the side of the felt termed the "back" (which is the side which will be stuck to the ball) is made of a material which provides good adhesion when it is glued on the internal rubber sphere of the ball. Usually the backing is formed by using 100% cotton warp yarns, but alternatives such as polyester and nylon could be used.

22

23 The tennis ball felt is then preferably dyed with a
24 fluorescent dyestuff. That is, the coloured felt
25 will absorb ultra-violet light and re-emit the
26 absorbed energy in the visible area of the spectrum.
27 Most tennis balls are now covered with felt that is
28 dyed fluorescent yellow and which produces peak
29 reflectance values of over 100% in the yellow area of
30 the spectrum.

31

1 Few manufacturers produce fluorescent dyestuffs
2 suitable for both wool and polyamide fibres. To the
3 best of the Applicant's knowledge all the major
4 tennis ball felt manufacturers use the same class of
5 dyestuff albeit from different dyestuff suppliers.
6 This class of dyestuff gives a hue (colour) slightly
7 to the green side of yellow.

8
9 The cones in the human eye are mainly responsible for
10 daylight colour vision and these give the eye the
11 highest visual efficiency in the yellow wavelengths.
12 In addition to percentage reflectance three other
13 values can be plotted to identify a colour:

14 |
15 Lightness, with a scale of 0 to 100, 0 being black
16 and 100 white;

17
18 Hue, which can be shown as a circle with red at 0
19 degrees and yellow, green and blue at 90 degree
20 intervals from this, the exact angle therefore
21 indicating the hue. If the lightness is visualised
22 as a vertical axis passing through the centre of the
23 hue circle, then a colour can be plotted in three
24 dimensional space; and

25 |
26 Chroma or colour saturation which can be shown as the
27 distance along a given radius from the centre of the
28 hue circle.

29
30 In the mid 1990's a high visibility yellow felt (or
31 Hi.Viz. F/Y) was produced using an increased

1 percentage of dyestuff. This felt (or Hi.Viz. F/Y)
2 has a higher level of saturation (chroma) but
3 actually has a slight reduction in peak reflectance
4 and in lightness when compared to some standard
5 coloured felt.

6

7 A method has now been found which allows the
8 production of coloured felt for tennis balls having
9 enhanced visibility properties over the prior art.

10

11 The invention also provides a method of dyeing
12 material which produces an Ultra High Visibility
13 (UHV) felt which mitigates shortfalls of previously
14 available dyed felts.

15

16 More particularly, the invention provides a method of
17 dyeing fabric material (particularly fabric material
18 which is suitable for use in sports ball manufacture)
19 which method comprises contacting said fabric
20 material with a bleaching agent prior to or
21 simultaneously with contacting said fabric material
22 with a dyestuff providing said colour. The term
23 "fabric material" includes both piece goods, yarns
24 and also fibres in loose form.

25

26 The present invention is based on the fact that the
27 felt used to produce tennis balls typically has a
28 significant wool content (usually 40% or higher). —
29 However, the peak reflectance of natural wool fibre
30 in the yellow area of the spectrum is typically
31 around 75% due to the natural yellowish-tinge in even

1 the whitest wool. By means of comparison, titanium
2 dioxide treated nylon would typically have a 90%
3 reflectance. We have found that the naturally low
4 reflectance of wool limits the reflectance achievable
5 even with a fluorescent dye.

6

7 The need to bleach a yellowish-fibre (natural wool)
8 prior to or during dyeing that fibre yellow appears
9 counter-intuitive, but we have found that the
10 performance of the dye applied is greatly enhanced by
11 this step.

12

13 Preferably the material to be dyed is a felt and
14 especially a woven felt.

15

16 Preferably the material to be dyed comprises a
17 mixture of fibres of different types, for example, a
18 mixture of wool and synthetic (e.g. polyamide or
19 polyester) fibres. Preferred synthetic fibres are
20 polyamide fibres, for example Nylon 6,6 or Nylon 6.
21 We have found Nylon 6,6 to be most suitable. One or
22 more different synthetic fibres may be present in the
23 fabrics material.

24

25 The proportions of wool and synthetic fibres may vary
26 according to the consumer's requirements on cost and
27 performance of the fabric material. For woven
28 fabrics having warp and weft yarns, a wool content of
29 at least 20% (usually 25%) by weight of weft yarn is
30 required.

31

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1 We have found that better quality fabric material is
2 achieved with increased wool content - for example
3 30% or higher by weight of weft yarn. Typically a
4 wool content of 40% or above, for example 50% or 60%,
5 by weight of weft yarn achieves good results. It may
6 be desirable to use fabric having a wool content of
7 over 45% by weight of weft yarn and in certain high
8 quality fabric materials, like those used for high
9 quality tennis balls, over 50% (usually around 60%)
10 is used. In some cases the wool content may be even
11 higher (e.g. over 65% or 70% by weight of weft yarn)
12 and be 80% or over.

13
14 For woven fabric, the warp yarn will typically be a
15 cotton yarn, but polyester or polyamide (e.g. nylon)
16 could alternatively be used. For non-woven fabrics
17 (e.g. needlefeltd fabrics) or knitted fabrics a
18 lower wool content (for example in the range of 20-
19 40% by weight, preferably at least 25%) may be
20 sufficient. By "wool" we include wool-like fibres
21 (e.g. angora, cashmere and mohair) as well as the
22 more typical sheep's wool.

23
24 Nylon fibres having a circular cross-section have
25 been successfully used, but synthetic fibres having
26 other cross-sections (e.g. triangular or flattened)
27 are commercially available and may further increase
28 the reflectance achievable.

29
30 It is also preferred that the material is processed
31 as described in piece form. Preferably the fabric is

1 a felt and more particularly a felt suitable for the
2 covering of tennis balls. Since a mixture of fibre
3 types (wool and synthetic) are present in the fabric
4 material, it is recommended to contact the fabric
5 material also with a partitioning agent in order to
6 eliminate or reduce the difference in uptake of the
7 dyestuff between the different types of fibres. The
8 bleaching agent, which is preferably a reduction
9 bleaching agent, whitens the initial colour of at
10 least the wool.

11
12 Preferably the fabric material is treated using a
13 jet-dyeing apparatus and a liquor ratio of 6:1 to 8:1
14 is used to run the machine.

15
16 It is further preferred that the pH is adjusted
17 preferably between 4.2 and 4.5 by using, for example,
18 formic acid. The temperature is then raised to a
19 suitable temperature, for example about 45°C, and
20 held for a period of, typically, 3 minutes to be able
21 to check and if necessary adjust the pH.

22
23 A wide range of suitable partitioning agents are
24 available depending for example upon the nature of
25 the material to be treated. However the partitioning
26 agent sold under the Trade Name BASOPAL NA by BASF
27 plc of Cheshire, SK8 6QG, United Kingdom, has
28 demonstrated good results. BASOPAL NA is an
29 alkylarylsulphonate in water and comprises 50-60% by
30 weight of the salt of dodecylbenzenesulphonic and
31 triethanolamine. The concentration of BASOPAL NA

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recommended is about 0.5 grams per litre of liquor.
Alternative partitioning agents include THIOTAN RMFN LIQUID (an anionic sulphated fatty acid, pH 7 to 8 at 10% dilution) to be used at a concentration of 3.0 to 0.1% (o.w.f.); and ERIONAL RF of Ciba Speciality Chemicals Inc, Basel, Switzerland (an anionic condensation product of aromatic sulphonic acids and formaldehyde, pH 3.5 at 5% solution) to be used at a concentration of 0.5 to 6% gram per litre liquor.

10
11 It is further preferred that the bleaching agent and,
12 if appropriate, the partitioning agent be in contact
13 with the material for a reasonable length of time
14 (typically from 1 to 30 mins) prior to the dyeing
15 step being executed.

16
17 It is further preferred that the bleaching agent be
18 added simultaneously or quasi-simultaneously with the
19 partitioning agent.

The bleaching agent preferably used is the one sold under the Trade Name LUFIBROL FW by BASF plc of Cheshire, SK8 6QQ, United Kingdom. LUFIBROL FW is an inorganic reducing agent with chelating agents and comprises 30-40% by weight tetrasodium ethylene-diaminetetraacetate and 30-40% by weight disodium disulphite. The amount of LUBRIFOL FW used is advantageously about 2% of the weight of fibre. Alternative bleaching agents include LANALBIN BE powder (a non-ionic hydroxylamine derivative, pH 5.6-5.7 at 1 g/litre) to be used at a concentration of

1 1.0 to 4.0% (o.w.f.); and ERIOCLARITE B of Ciba
2 Speciality Chemicals Inc of Basle, Switzerland (an
3 anionic mixture of sodium metabisulphite with the
4 sodium salt of ethylenediamine tetraacetic acid, pH 6
5 at 5% solution) to be used at a concentration of 0.5
6 to 1 g/litre.

7

8 It is preferred to use a fluorescent dye.

9 It is further preferred to use a yellow dye, as this
10 colour is highly desirable for the manufacture of
11 tennis balls. The preferred yellow dye which can be
12 used according to the invention is a dye having a
13 colour index number acid yellow 250, for example the
14 one sold under the Trade Name NYLOMINE FLAVINE C-7G
15 dyestuff by BASF plc, of Cheshire, SK8 6QG, United
16 Kingdom. The dyeing step can be performed according
17 to the recommended practice. A typical method is to
18 add the dyestuff to the material and the liquor
19 according to a recommended concentration and the
20 temperature is then raised to the recommended level
21 and held for some time at this temperature before
22 rinsing.

23

24 The method of the invention also provides a white
25 fabric material having enhanced visibility
26 properties. The method is similar to that described
27 above except that the "dyestuff" referred to is an
28 optical brightening agent. Optical brightening
29 agents are commonly used in the dyeing industry. The
30 brightening agent sold under the trade name UVITEX

1 NFB by Ciba Speciality Chemicals Inc of Basle,
2 Switzerland can advantageously be used.

3

4 The invention also relates to the dyed material,
5 preferably a felt, and more preferably a woven felt,
6 obtained according to the method of the invention
7 which is coloured, preferably in yellow, and displays
8 enhanced visibility properties.

9

10 The invention further relates to the use of coloured
11 fabric material dyed according to the method of the
12 invention in the manufacture of articles such as
13 sporting articles and more particularly tennis balls.

14

15 The invention further relates to sporting articles
16 comprising the dyed fabric material, and more
17 particularly to sports balls (in particular tennis
18 balls) covered with such material.

19

20 The present invention provides a fabric material
21 suitable for use in sports ball manufacture, wherein
22 said material includes wool fibres and exhibits the
23 following characteristics:

24

25 a) for a coloured (non-white) fabric material:

2

2

3

31 b) for a white fabric material:

- 1 i) a chroma value of 14 or less;
- 2 ii) a lightness value of 85 or more; and
- 3 iii) a reflectance value of 100 or more.

4

5 When the dyed material is a woven fabric having warp
6 and weft yarns, a wool content of at least 20%
7 (usually 25%) by weight of weft yarn is required.

8 Desirably, the wool content includes at least 30% or
9 more, preferably 40% or more, by weight of weft yarn.

10 It may be desirable to use fabric having a wool
11 content of over 45% by weight of weft yarn and in
12 certain high quality fabric materials, like those
13 used for high quality tennis balls, over 50% (usually
14 around 60%) is used. In some cases the wool content
15 may be even higher (e.g. 65% or 70% by weight of weft
16 yarn) and be 80% or over.

17

18 For non-woven fabric the minimum amount of wool
19 required is about 20% by weight. Desirably, the wool
20 content includes at least 30% or more, preferably 40%
21 or more, by weight. It may be desirable to use over
22 45% by weight of wool and in certain high quality
23 fabric materials 50% by weight of wool, or even 60%
24 by weight of wool (e.g. 65% by weight of wool or even
25 up to 70% by weight of wool) may be employed.

26

27 For a coloured (non-white) fabric material the chroma
28 value may be higher than 100 (for example 102 or
29 more, preferably 105 or more) and, generally, a high
30 chroma value is desirable provided that the minimum
31 lightness and reflectance values given above for a

1 coloured (non-white) fabric material are maintained.
2 We have achieved a chroma value of over 110,
3 specifically a value of 113.4.

Likewise, for a coloured (non-white) fabric material a lightness value of greater than 95 is desirable (for example of 96 or more, or even 97 or more) provided that the minimum chroma and reflectance values given above for a coloured (non-white) fabric material are also maintained.

Similarly, for a coloured (non-white) fabric material a reflectance value of over 120 (for example 125 or more, preferably 128 or more) is desirable provided that the minimum lightness and chroma values given above for a coloured (non-white) fabric material are also maintained. We have achieved a reflectance value of over 129, specifically a value of 129.9.

19
20 In a preferred embodiment, the coloured (non-white)
21 fabric material according to the present invention
22 exhibits the following characteristics:

- 23 i) a chroma value of 105 or more
24 (preferably 110 or more);
25 ii) a lightness value of 96 or more
26 (preferably 97 or more); and
27 iii) a reflectance value of 125 or more
28 (preferably 128 or more).

30 Preferably the coloured (non-white) fabric material
31 is a yellow material.

1 For a white fabric material, the chroma value is
2 desirably lower than 10 (for example is 8 or less,
3 preferably is 5 or less) and, generally, a low chroma
4 value (indicating absence of colour) is desirable
5 provided that the minimum lightness and reflectance
6 values given above for a white fabric material are
7 maintained.

8
9 Likewise, for a white fabric material a lightness
10 value of greater than 85 is desirable (for example of
11 88 or more, 89 or more, or 90 or more) provided that
12 the maximum chroma value and minimum reflectance
13 value given above for a white fabric material are
14 maintained.

15
16 Similarly, for a white fabric material, a reflectance
17 value of over 100 (for example 102 or more, 105 or
18 more or 106 or more) is desirable provided that the
19 maximum chroma value and minimum reflectance value
20 given above for a white fabric material are
21 maintained.

22
23 In a preferred embodiment, the white fabric material
24 according to the present invention exhibits the
25 following characteristics:

- 26
27 i) a chroma value of 8 or less
28 (preferably 5 or less);
29 ii) a lightness value of 92 or more
30 (preferably 93 or more); and

3

4 The present invention further provides a sports ball
5 having a fabric material surface (for example a
6 tennis ball) wherein said sports ball is manufactured
7 using a fabric material as defined above.

8

9 In a further aspect, the present invention provides a
10 sports ball having a fabric material outer surface
11 (for example a tennis ball) wherein said fabric
12 material forming said outer surface includes wool
13 fibres and exhibits the chroma, lightness and
14 reflectance value described above.

15

16 In a further aspect, the present invention provides a
17 sports ball having a white fabric material outer
18 surface (for example a tennis ball) wherein said
19 fabric material forming said outer surface includes
20 wool fibres and exhibits the following
21 characteristics :

23

- i) a chroma value of 10 or less;
 - ii) a lightness value of 90 or more; and
 - iii) a reflectance value of 80 or more.

2

27 When the dyed material is a woven fabric having warp
28 and weft yarns, a wool content of at least 20%
29 (usually 25%) by weight of weft yarn is required.

3

31 preferably 40% or more, by weight of weft yarn. It

1 may be desirable to use fabric having a wool content
2 of over 45% by weight of weft yarn and in certain
3 high quality fabric materials, like those used for
4 high quality tennis balls, over 50% (usually around
5 60%) is used. In some cases the wool content may be
6 even higher (e.g. over 65% or 70% by weight of weft
7 yarn) and be 80% or over.

8

9 For non-woven fabric the minimum amount of wool
10 required is about 20% by weight. Desirably, the wool
11 content includes at least 30% or more, preferably 40%
12 or more, by weight. It may be desirable to use over
13 45% by weight of wool and in certain high quality
14 fabric materials 50% by weight of wool, or even 60%
15 by weight of wool (e.g. 65% by weight of wool or even
16 up to 70% by weight of wool) may be employed.

17

18 For a white fabric material, the chroma value is
19 desirably lower than 10 (for example is 8 or less,
20 preferably is 5 or less) and, generally, a low chroma
21 value (indicating absence of colour) is desirable
22 provided that the minimum lightness and reflectance
23 values given above for a white fabric material are
24 maintained.

25

26 Likewise, for a white fabric material a lightness
27 value of greater than 90 is desirable (for example of
28 92 or more, 93 or more, or 94 or more) provided that
29 the maximum chroma value and minimum reflectance
30 value given above for a white fabric material are
31 maintained.

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1 Similarly, for a white fabric material, a reflectance
2 value of over 80 (for example 85 or more, 90 or more
3 or 95 or more) is desirable provided that the maximum
4 chroma value and minimum reflectance value given
5 above for a white fabric material are maintained.

6

7 In a preferred embodiment, the white fabric material
8 according to the present invention exhibits the
9 following characteristics:

10

- 11 i) a chroma value of 8 or less
12 (preferably 5 or less);
13 ii) a lightness value of 92 or more
14 (preferably 93 or more); and
15 iii) a reflectance value of 85 or more
16 (preferably 90 or more).

17

18 The invention as described above with reference to

19 coloured (non-white) fabric material (both in respect
20 of the fabric material per se and in respect of the
21 sports ball having a fabric material outer surface)
22 preferably refers to a yellow fabric material.

23 References to "yellow" refer to any non-white fabric
24 material which is acceptable to the International
25 Tennis Federation (I.T.F.) (since yellow is an
26 accepted coloration of tennis ball according to the
27 I.T.F.). However, this is not exclusive, and other
28 coloured fabric materials (for example pink, green,
29 blue, etc) are also encompassed.

30

1 The present invention will be now further described
2 with reference to the following, non-limiting example
3 and Figures in which:

4

5 **Figure 1** shows the reflectance curves of two prior
6 art felts in ball form (Nos 2 & 3) compared with the
7 Ultra High Visibility yellow felt (UHV F/Y) in fabric
8 form (No 1) of the invention.

9

10 **Figure 2** shows the reflectance curves of two other
11 felts (Nos 4 & 5) produced by the Applicant and
12 compared with the UHV F/Y felt (No 1) of the
13 invention, all in fabric form.

14

15 **Figure 3** shows the same data as Figure 2 but the data
16 used to produce the curves are generated by the
17 International Tennis Federation on their
18 spectrophotometer.

19

20 **Figure 4** shows the saturation (chroma) of the UHV F/Y
21 felt (No 1) of the invention compared with the four
22 prior art felts (Nos 2 to 5) used in Figures 1 to 3.
23

24 **Figure 5** shows the lightness of the same five felts
25 used in Figure 4.

26

27 **Figure 6** is an attempt to illustrate the position on
28 the colour circle by both chroma and hue of the five
29 samples used in the comparative data shown in Figures
30 1 to 5.

31

1 Example 1

2 Production of an ultra high visibility yellow felt
3 according to the method of the invention

4

5 The felt used in this example is a fabric material
6 having an back surface made mainly in cotton and a
7 face side made of a wool and polyamide fibre felt
8 (the face side of the fabric forms the external face
9 of the ball). Only the face surface made of wool and
10 polyamide felt needs to be coloured. Wool and
11 polyamide are present in the weft in a ratio of about
12 60:40 with respect to the weight of wool and
13 polyamide fibres. The amount of cotton fibres in the
14 material represents about 15 % of the total weight of
15 the fabric material.

16

17 The felt is dyed using acid dyes in piece form using
18 a Softflow jet dyeing machine which is run at a
19 liquor ratio of between 6:1 and 8:1. The liquor is
20 the liquid in which the material is wetted before
21 the addition of the dyestuff. In most cases and in
22 particular in this example the liquor is water.

23

24 The dyeing method used in this example is as
25 follows:-

- 26 - The felt is entered into the machine cold and
27 the liquor ratio as indicated above;
- 28 - The pH is adjusted between 4.2 and 4.5 with
29 formic acid;
- 30 - The temperature is raised to 45°C and held for
31 3 minutes whilst checking pH;

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1 - 0.5 grams per litre of BASOPAL NA (BASF) and
2 2% by weight of fibre of Lufibrol FW (BASF) are
3 added through the dosing system; and
4 - the machine is run for 5 minutes at 45°C.

5 The following dyeing method is then applied:

6 - 1.6% by weight of fibres of NYLOMINE
7 FLAVINE C-7G dyestuff is added through the
8 dosing system during a period of 2 minutes;
9 - the temperature is raised at a rate of
10 1.8°C per minute to 95°C and the machine is
11 run for 30 minutes at this temperature;
12 - the temperature is decreased to 40°C at a
13 rate of 2.5°C per minute; and
14 - the felt is rinsed twice with fresh water
15 and unloaded from the machine.

16

17 **Comparative data**

18

19 The colour characteristics of the felt dyed according
20 to the above described method are shown in Figures 1
21 to 6. Except for Figure 3, all data were measured by
22 the Applicant using CIE (Commission Internationale
23 d'Eclairage) CIELAB formula at a 10 degree
24 reflectance angle using standard D65 illuminant.

25

26 Figure 1 shows reflectance curves of an UHV yellow
27 felt (UHV F/Y) made according the method described in
28 Example 1 and of two competing felts in the form of
29 tennis balls produced respectively for the companies
30 Tretorn Sport and Penn Racquet Sports under the Trade
31 Names TRETORN TXT and PRO PENN. The felts used to

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1 cover these balls are produced by Textech Industries.
2 We have found only minimal difference in the
3 spectrophotometric measurements made between a fabric
4 in sheet form and the same fabric when in the form of
5 completed tennis balls.

6

7 Figure 2 shows reflectance curves of the UHV F/Y felt
8 used in Figure 1 and of two other yellow felts, a
9 "standard" (Std.F/Y) one and an "high visibility" one
10 (Hi. Viz. F/Y), both produced by the company Milliken
11 (Woollen Speciality Products) under the respective
12 Trade Names PLAYNE'S 14 and PLAYNE'S 45. These felts
13 are used in the manufacture of tennis balls such as
14 the ones sold under the Trade Names DUNLOP FORT
15 (standard) and SLAZENGER WIMBLEDON (high visibility).

16

17 Figure 3 shows the same data as Figure 2 but the data
18 used to produce the curves are generated by the
19 International Tennis Federation (ITF) on their
20 spectrophotometer. This independent measurement shows
21 good correlation with the Applicant's own data.

22

23 Figures 4 and 5 show respectively the chroma and the
24 lightness of the five tested felts.

25

26 Figure 6 shows a graph displaying the combination of
27 both chroma and hue performances of the five tested
28 felts.

29

30 As can be seen from Figures 1 to 6, the colour of the
31 felt of this example of the invention demonstrates

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1 superior characteristics in all areas (i.e. chroma,
2 hue lightness and reflectance). The performances,
3 when compared to the closest prior art (i.e. the High
4 Visibility felt manufactured by Milliken), are
5 especially better for lightness and reflectance.

6

7 Figures 2 to 4 & 5 show that the high visibility felt
8 has a higher level of saturation (chroma) but
9 actually has a slight reduction in peak reflectance
10 and in lightness when compared to the standard colour
11 felt. This disadvantage does not exist with the
12 colour of the UHV felt.

13

14 A summary table of the peak reflectance level,
15 chroma, hue and lightness for the fabric according to
16 the invention (UHV F/Y) and for the commercially
17 available alternatives used above and a natural white
18 tennis ball felt is given in Table 1 below.

19

Table 1

Product	Peak Reflectance Level	Chroma (Saturation)	Hue	Lightness
Natural White Tennis Ball Felt	78.46	8.9	92.4	87.8
Milliken Standard Yellow Felt (Std.F/Y)	122.4	98.2	108.8	96.5
Milliken High Visibility Yellow felt (Hi.Viz.F/Y)	119.8	112.0	101.3	94.2
UHV F/Y	129.9	113.4	104.7	97.9
Tretorn TXT Ball	113.1	100.9	104.5	93.6
Pro Penn Ball	124.4	95.8	108.1	95.7

1 Thus, the UHV F/Y felt of this invention can be used
2 for the manufacture of yellow tennis balls of
3 improved colour properties, which is obviously highly
4 desirable to tennis players. Such improved
5 properties permit, during a game, a more easy and
6 rapid catch (visualisation) of the incoming moving
7 ball by the tennis player and thus a quicker reaction
8 and positioning of the player with respect the ball.
9

10 The method and the product thus produced according to
11 the invention may be used for other purposes than
12 covering tennis balls. The high visibility of colour
13 material of the invention could also be used for
14 producing other items than tennis balls, especially
15 those where high visibility is important (for example
16 footballs - especially for indoor use - basketballs
17 and volleyballs).

18
19 Alternative dyeing technologies may be used, and
20 specific mention may be made of the following:
21

22 1. Winch beck

23
24 Winch beck dyeing is an alternative technology for
25 dyeing piece goods and pre-dates the Softflow jet-
26 dyeing apparatus. Whilst the dyeing method is
27 essentially the same as for jet-dyeing the liquor
28 ratio would be higher, normally 20:1 to 25:1.
29

30 In simple terms, this is a vertical stainless steel
31 tank; the top half of one side lifts up and down for

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1 access and the top is vented. A large roller known
2 as a winch is contained within the top section.
3 There is a heating coil in the bottom section.

4

5 The tank is partially filled with water and the cloth
6 is then passed over the winch roller, through the
7 water and then back out of the machine. The two ends
8 of the cloth are sewn together to make an endless
9 rope. The winch is driven to continually rotate the
10 rope through the water.

11

12 Dyes and chemicals are pre-dissolved and then added
13 to the water. Steam is passed through the heating
14 coil to raise the bath temperature to 98°C. This
15 temperature is held for 30-45 minutes, after which
16 the tank is cooled by filling with cold water and
17 then draining. This is repeated until a safe
18 handling temperature is achieved after which the
19 cloth is removed.

20

21 Products used in the bath:

22

23 Fluorescent yellow dyestuff - colouring material.
24 Glauber salts - acts as a levelling agent.
25 Formic acid - to lower the pH making the cloth more
26 attractive to dyestuff.

27

28 2. Loose stock machine

29

30 This is a circular stainless steel tank (or vat),
31 from 1 metre to 3 metres diameter, which is partially

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1 filled with water. The material, in the form of
2 loose wool and/or nylon fibres, which have been pre-
3 washed is loaded into a cage. This cage then has a
4 lid attached and is placed inside the outer tank.
5 Dyestuff and chemicals are pre-dissolved inside a
6 header tank and then pumped into the tank and through
7 the stock in the cage.

8

9 The temperature of the vat is raised to 98°C and held
10 for 30-45 minutes. The dye liquor is drained and
11 fresh cold water pumped through to rinse and cool the
12 loose stock.

13

14 The products used are the same as for winch dyeing.

15

16 After dyeing the fibres are processed into fabric
17 form.

18

19 3. Package dyeing

20

21 Yarn is wound onto a stainless-steel cylinder which
22 is perforated, allowing the dyeing liquor to be
23 pumped through the yarn package from inside to out
24 and vice versa. The yarn package is loaded into a
25 circular, stainless steel tank and then pre-dissolved
26 dyes and chemicals are pumped in.

27

28 The temperature of the liquor is raised to 98°C by a
29 steam heating coil. This temperature is maintained
30 for approximately 1 hour. The packages are then
31 rinsed with cool water to cool the bath and remove

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1 residual dyestuff. The batch is left to drain and
2 then removed from the vessel.

3

4 Products used are the same as for winch dyeing.

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